BUILDING INFORMATION MODELING *in the Air Force*

Maj Patrick Suermann, P.E., AFIT/CIP
Raymond Issa, Ph.D., J.D., P.E., University of Florida

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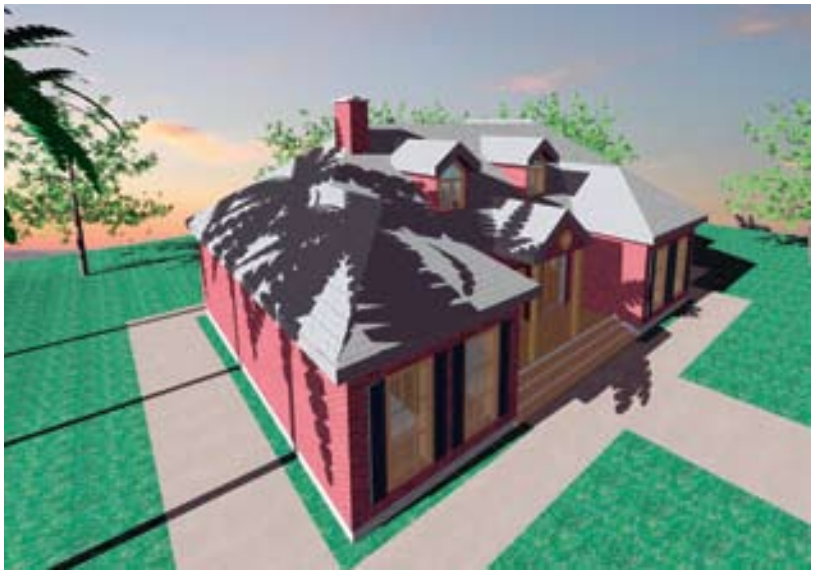


While the Air Force is not a business, the Air Force's mission is executed most successfully when we make good business decisions. Like any company, the Air Force periodically needs to re-evaluate its primary mission requirements and tailor its core competencies and accompanying information management practices accordingly. This consideration is the driver for one part of Civil Engineering's Transformation goal of "20/20 by 2020": to reduce the Air Force's infrastructure life cycle funding requirement 20% by 2020, through efficiencies and management strategies.

Many stakeholders in the AECO — architecture, engineering, construction, and operations— community have already accomplished such business process reengineering. Regarding designing and managing facilities, Building Information Modeling, or BIM, is one shared solution among those who have implemented successful strategies for improving their business processes and information management.

What is BIM and who uses it?

BIM is a method for incorporating valuable information into a facility model. The information can be used throughout the facility's life cycle: design, construction, operations, and sustainment. As defined by the National Institute of Building Sciences in their National BIM Standard, the "M" in BIM is used interchangeably for both "Model" and "Modeling." The "Model" is a virtual representation of physical and functional characteristics of a facility, and "Modeling"

is the creation, manipulation, and collaboration of the data stored within the virtual building model.

Wherever professionals want to eliminate redundant creation of data in favor of reusing building data, you will find BIM. General Motors and the General Services Administration have already mandated BIM for design, construction, and asset management. While there are significant real property asset management benefits to be derived from BIM, there are also many benefits of a BIM approach in the design phase of a project, which explains why architects are currently the greatest BIM proponents.

The U.S. Army Corps of Engineers has done a great deal of research and work with BIM and is regarded as an industry expert (see "How BIM Is Different from CADD and Why You Should Care" below). In 2005, two USACE Districts (Seattle and Louisville) implemented pilot BIM projects that served as test beds for creating the virtual models used in estimating, phasing, and geospatial integration that have changed how the Army designs, constructs, and operates its facilities. BIM is the primary technological component for the Army's solution to accomplishing its MILCON Transformation initiative that seeks construction improvement through a 15% cost decrease, 30% quicker execution, and quality improvements associated with 50-year facility life cycles. On the heels of the BIM pilot projects and MILCON Transformation mandates, the Army's Engineer Research and Development Center in Vicksburg, Miss., published the "USACE BIM Roadmap" (ERDC TR-06-10). This 100-page, easy-to-read publication has served as a relative "BIM for Dummies" for many AECO firms in private industry as they begin to wade into the waters of BIM implementation.

BIM in the Air Force

Although not widely adopted, BIM has already been used in the Air Force in a variety of ways.

The Air Force Theater Hospital at Balad AB, Iraq, is a facility designed and coordinated through BIM. In the spring of 2006, Army Capt Russell Manning, an architect and doctoral candidate at Penn State University, was recalled to active duty to help the Army Health Facility Planning group rapidly redesign a modular hospital for Balad.

According to Capt Manning, the original 2D concept drawings were completed by a seasoned stateside architect in 2-D CADD, but took over 350 hours and 24 months to design. Using a leading BIM software platform, Capt Manning redesigned the entire facility with major modifications in only 214 hours of design time over 44 days. Even more impressive, the redesign was done "on the ground" in-theater, but thoroughly scrutinized and coordinated with stateside subject matter experts, as well as a planning team and contracting office in Europe. A significant change in mission and scope during design coordination required a great deal of modifications to the design concept. Through the parametric connectivity of the data within the model, Capt Manning was able to validate programming requirements and make the necessary changes in hours, rather than months. The true testament to BIM's efficacy was that, after construction by a design-build contractor in 2007, the hospital had a layout and functionality nearly identical to Capt Manning's conceptual design.

Closer to home, BIM has already been implemented in the Department of Civil and Environmental Engineering at the U.S. Air Force Academy. Since the spring of 2004 (more than three years before the publication of the National BIM

How BIM Is Different from CADD and Why You Should Care

Mr. Stephen Spangler, ERDC-ITL

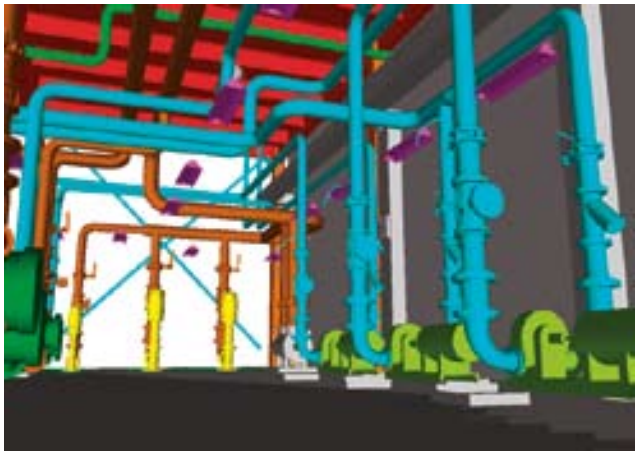
Building Information Modeling, or BIM, represents an important technology leap in the capturing of design information about a building or structure. It has significant value as an interchange mechanism between the tools used to perform the various functions of architecture, engineering, and construction.

A common misconception is that CADD is for 2D design and BIM is for 3D design. This is definitely not the case, since you can easily create 3D designs with CADD technology. The main difference between CADD and BIM all comes down to how an object perceives itself after it is placed. In CADD, when you place window or door symbols in a wall, you have to break the wall's lines and do some clean up to create your openings. If the walls or doors have to be moved later in the design process, the wall lines have to be reconnected and a new opening has to be created. With BIM, you are dealing with objects that are simulations of building components. When you place a wall in BIM, it knows that it is a wall. A wall object contains information about its materials, its fire rating, and height (just to name a few). When you place a door object into a wall object, the opening is automatically created. If you have to move the door, the wall opening is filled in and an opening is created in the door's new location.

While CADD is still an excellent tool for design, BIM technology allows the passing of information throughout all the phases of a structure's life cycle. But CADD skills won't be wasted. Many traditional drafting skills are constantly used working in BIM software and, after a BIM model is created, extractions are taken from the model and used to create model files and sheet files. Once at the stage where construction documents are assembled, CADD skills are used 100%.

BIM also allows for time and cost savings that could not be realized through CADD technology. Problems are more easily discovered in the design phase because the developed model more accurately reflects what is being constructed in the field. Interference detection analyses can be run on the model prior to construction, determining where beams run into each other, or where ducts run into pipes. Besides interference detection, BIM technology can be used for modeling, drafting, visualizing, animating, simulating, analyzing, and plotting to name a few of its capabilities.

Mr. Spangler is a mechanical engineer, CAD/BIM Technology Center, U.S. Army Engineer Research and Development Center, Vicksburg, Miss.



Designed in 2000 using BIM software, this award-winning F-22 robotic coatings facility ended up with a layout and functionality almost identical to the conceptual design. (design drawing and photo courtesy of Burns and McDonnell)

Standard), sophomore cadets have been creating parametric information-attributed virtual building models. In only ten lessons and approximately 30-60 hours, cadets have designed "dream homes" that were completely furnished, landscaped, and rendered for worldwide locations with real-world lighting conditions specific to the area and time of day of their choosing.

Cadets' knowledge of BIM has led to success in regional competitions. In both 2006 and 2007, they placed in the top three at the Associated Schools of Construction Commercial and Design Build Competitions, beating teams of architects and construction science students from civilian schools who had devoted far more time to preparing for the competition. Cadet renderings have also been used to convey design intent to general officers for renovation of Fairchild Hall, the Academy's 1 million square foot academic building.

The Future

Where do we go from here? Strategically, BIM is being evaluated by the teams accomplishing the "high-level capabilities mapping" efforts for possible inclusion in the next generation Civil Engineering IT framework, "Agile Installation Management," although they are first looking to practitioners to demonstrate successful business cases that will provide a compelling argument for Air Force-wide adoption.

Operationally, engineers and architects like Mr. Gene Mesick, AIA, and Mr. Rick Sinkfield, AIA, from the Air Force Center for Engineering and the Environment have already made efforts to incorporate BIM on some projects to determine the best way forward with the process. Eventually, AFCEE plans to roll the BIM effort into a spectrum of prescriptive- to performance-based request-for-proposal development tools called Dynamic Prototyping. However, much work remains in the areas of cost integration, model development, customer/stakeholder buy-in, and sustainable performance measures. The vision is a dynamic model that can be developed throughout the programming, design, construction, and, ultimately, operational phases of a building.

Tactically, Civil Engineering education centers like the U.S. Air Force Academy, the Air Force Institute of Technology, and the Air Force Civil Engineer Support Agency should supplement their existing successful training programs and build an Air Force-wide BIM training curricula to help our overtaxed engineers and engineering assistants add this new skill to their burgeoning skill sets.

As the AECO industry evolves, and in order to align our operations with industry best practices, it is critical that we integrate Building Information Modeling into the Air Force roadmap for success.

Authors' note — For more information about BIM, visit the following Web sites:

- http://www.facilityinformationcouncil.org/bim
- http://www.gsa.gov/bim
- https://cadbim.usace.army.mil
- https://cadbim.usace.army.mil/Myfiles/1/ERDC_TR-06-10.pdf
- http://www.bimforum.org/
- http://vector1media.com/spatialsustain/?p=448

Maj Suermann is a former Assistant Professor, U.S. Air Force Academy, Colo. He is currently a doctoral candidate in Design, Construction, and Planning at the University of Florida, Gainesville, Fla., as the first Rinker Scholar. He serves on the National BIM Standard executive committee as the Testing Team Leader and co-wrote several sections of the standard.

Dr. Issa is the Director of Graduate and Distance Education Programs as well as a tenured Rinker Professor at the M.E. Rinker, Sr., School of Building Construction at the University of Florida. He is an internationally recognized expert and consultant on implementing technology in construction.